CLAIMS

What is claimed is:

1. A method of identifying a presence of a first material having a first transverse nuclear magnetic spin relaxation time T_2 in a mixture with a second material having a second transverse nuclear magnetic spin relaxation time T_2' greater than said first transverse relaxation time, said first material comprising a small fraction of the mixture, the method comprising:

(a) using a magnet to produce a static field in a region of examination and align nuclear spins in said region substantially parallel to a direction of said static field;

(b) applying a pulse sequence

A1 - τ - B1 -τ - A2 - TW - A3

where A1 is a first excitation pulse, τ is a Carr-Purcell time, B1 is a first refocusing pulse, A2 is forced inversion pulse, A3 is a second excitation pulse, and TW is a wait time, and

(c) determining a value of TW for which a resulting signal from said second material is substantially zero.

2. The method of claim 1 wherein said first excitation pulse comprises a pulse having a tip angle substantially equal to 90^0.

3. The method of claim 1 wherein said second excitation pulse comprises a pulse

having a tip angle substantially equal to 90^0.

4. The method of claim 1 wherein said first refocusing pulse comprises a pulse having a tip angle substantially equal to 180^0.

5. The method of claim 1 wherein determining said value of TW further comprises applying a sequence of refocusing pulses B_{2i} after said second excitation pulse and determining a value of TW for which substantially no spin echo signals are produced by said sequence of refocusing pulses.

6. The method of claim 5 wherein at least one of said sequence of refocusing pulses comprises a pulse with a tip angle substantially equal to 180^0.

7. The method of claim 1 further selecting τ to satisfy the condition $T_2' >> \tau >> T_2$.

8. The method of claim 5 further comprising:

(i) repeating (b) with different values of TW until no free induction decay signal after the second excitation pulse A3 is produced;

(ii) repeating (b) with a value of TW altered from the value determined in (i); and

(iii) analyzing a resulting free induction decay signal.

9. The method of claim 1 wherein said first material and said second material are fluids in an earth formation.

10. The method of claim 9 further comprising conveying said magnet on a logging tool into a borehole into said earth formation.

11. The method of claim 10 wherein said logging tool is conveyed on a wireline.

12. The method of claim 10 wherein said logging tool is conveyed on a drilling tubular.

13. A system for identifying a presence of first fluid having a first transverse nuclear spin relaxation time T_2 in a mixture in an earth formation with a second fluid having a second transverse spin relaxation time T_2 ' greater than said first transverse relaxation time, said first fluid comprising a small fraction of the second fluid, the method comprising:

(a) a logging tool conveyed into a borehole into said earth formation,

(b) a magnet on said logging tool for producing a static field in a region of said earth formation including said mixture, said magnet aligning nuclear spins in said region substantially parallel to a direction of said static field;

(b) a transmitter on said logging tool for applying a radio frequency pulse sequence

A1 - τ - B1 -τ - A2 - TW - A3

to said mixture in said region, where A1 is a first excitation pulse, τ is a Carr-Purcell time, B1 is a first refocusing pulse , A2 is forced inversion pulse, and A3 is a second excitation pulse,

(c) a receiver on said logging tool for receiving signals resulting from said nuclear spins resulting from application of said pulse sequence; and

(d) a processor for determining a value of TW for which a resulting signal from said second fluid is substantially zero.

14. The system of claim 13 wherein said first excitation pulse comprises a pulse having a tip angle substantially equal to 90^0.

15. The system of claim 13 wherein said second excitation pulse comprises a pulse having a tip angle substantially equal to 90^0.

16. The system of claim 13 wherein determining said value of TW further comprises applying a sequence of refocusing pulses B_{2i} after said second excitation pulse and determining a value of TW for which substantially no spin echo signals are produced by said sequence of refocusing pules

17. The system of claim 13 wherein said first refocusing pulse comprises a pulse

having a tip angle substantially equal to 180°.

18. The system of claim 16 wherein at least one of said sequence of refocusing pulses comprises a pulse with a tip angle substantially equal to 180°.

19. The system of claim 13 wherein $T_2' >> \tau >> T_2$.

20. The system of claim 13 wherein said processor further performs:

(i) a repetition of (b) in claim 13 with different values of TW until no free induction decay signal after the second excitation pulse A3 is produced;

(ii) a repetition of (b) in claim 13 with the value of TW altered from the value determined in (i); and

(iii) analyzes a resulting free induction decay signal.

21. The system of claim 13 further comprising a wireline for conveying said logging tool into said borehole. .

22. The system of claim 13 further comprising a drilling tubular for conveying said logging tool into said borehole.

23. .The system of claim 13 wherein said processor is on said logging tool.